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(54) **ANTENNA MODULE AND METHOD FOR MAKING THE SAME**

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H01Q 1/38 (2006.01)

(52) **U.S. Cl.**
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(58) **Field of Classification Search**
USPC ..... 343/702, 700 MS
See application file for complete search history.

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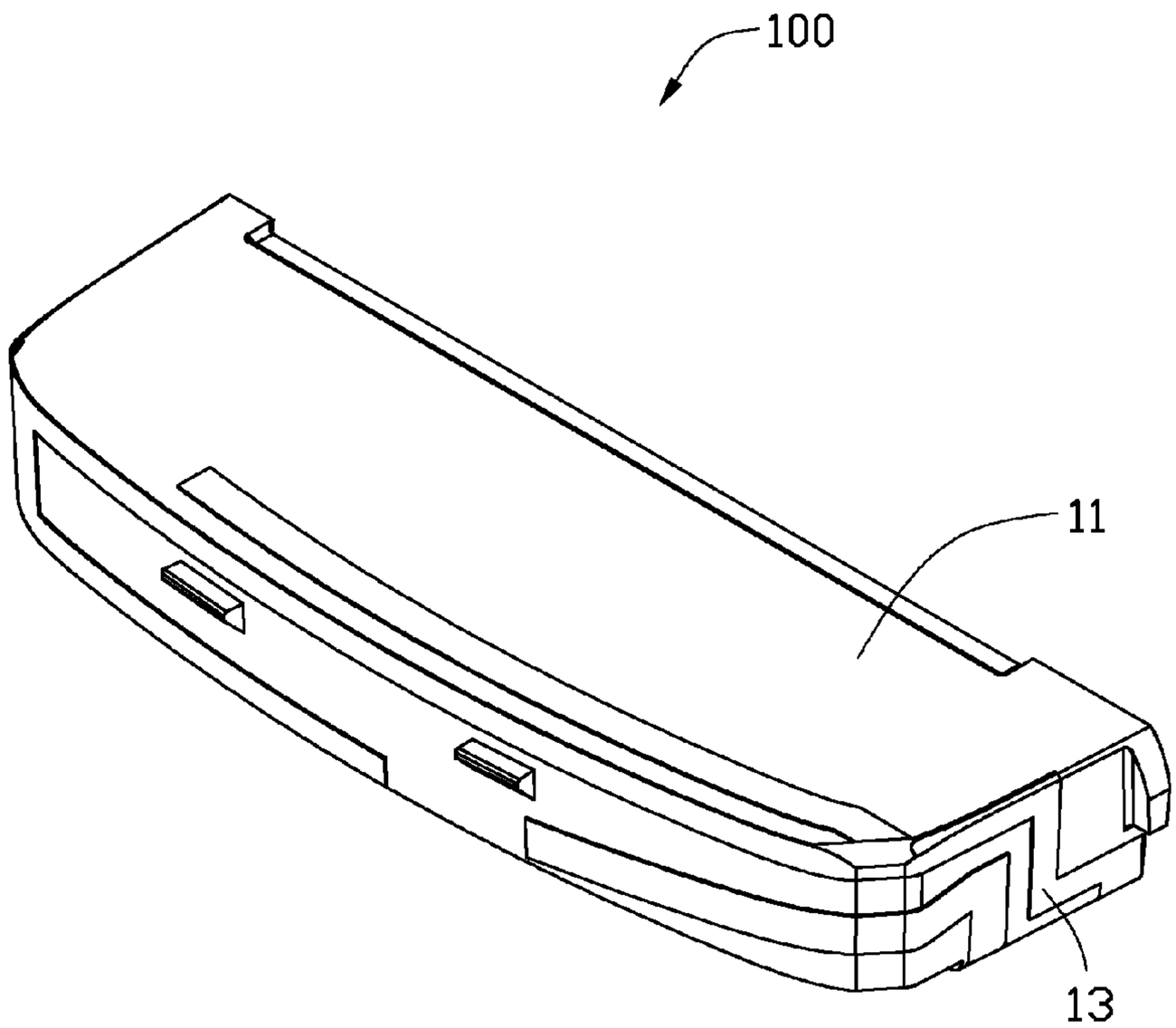
(57) **ABSTRACT**

An antenna module includes a main body and an antenna radiator located on the main body. The antenna radiator is made of a liquid conductive material mixed by metal powders and diluting agent and is directly formed on the main body. A method for making the antenna module is also described.

13 Claims, 3 Drawing Sheets



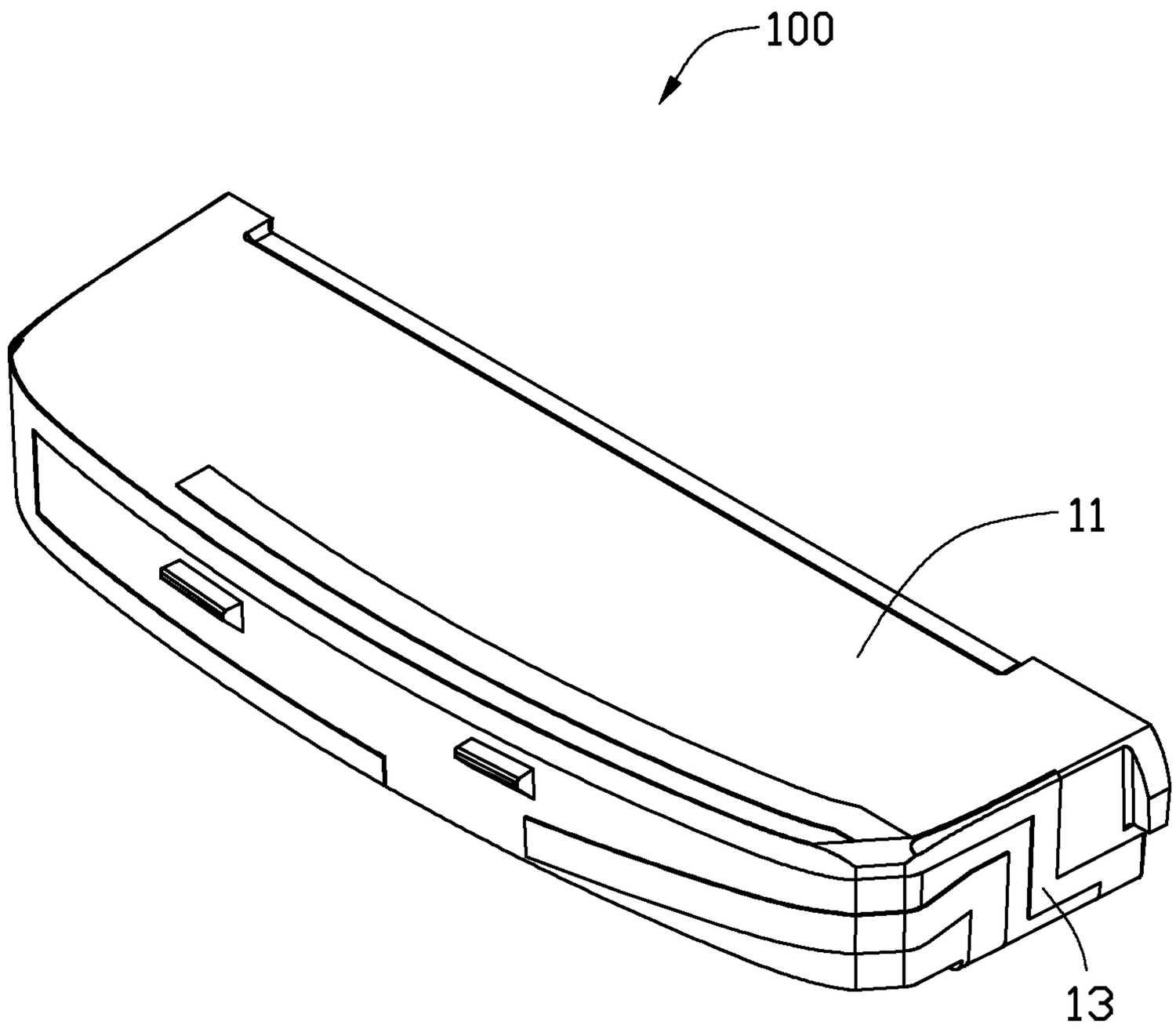


FIG. 1

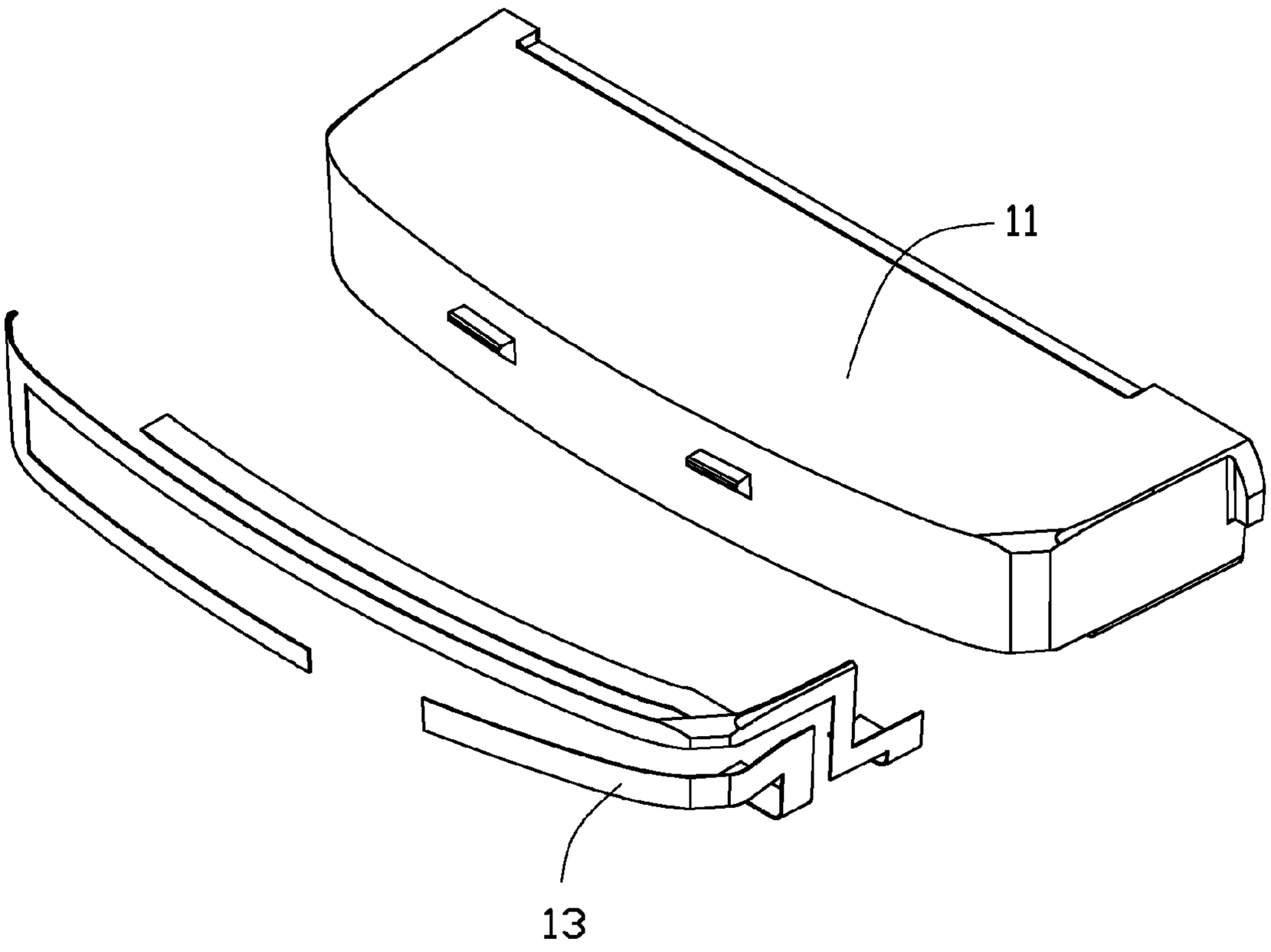


FIG. 2

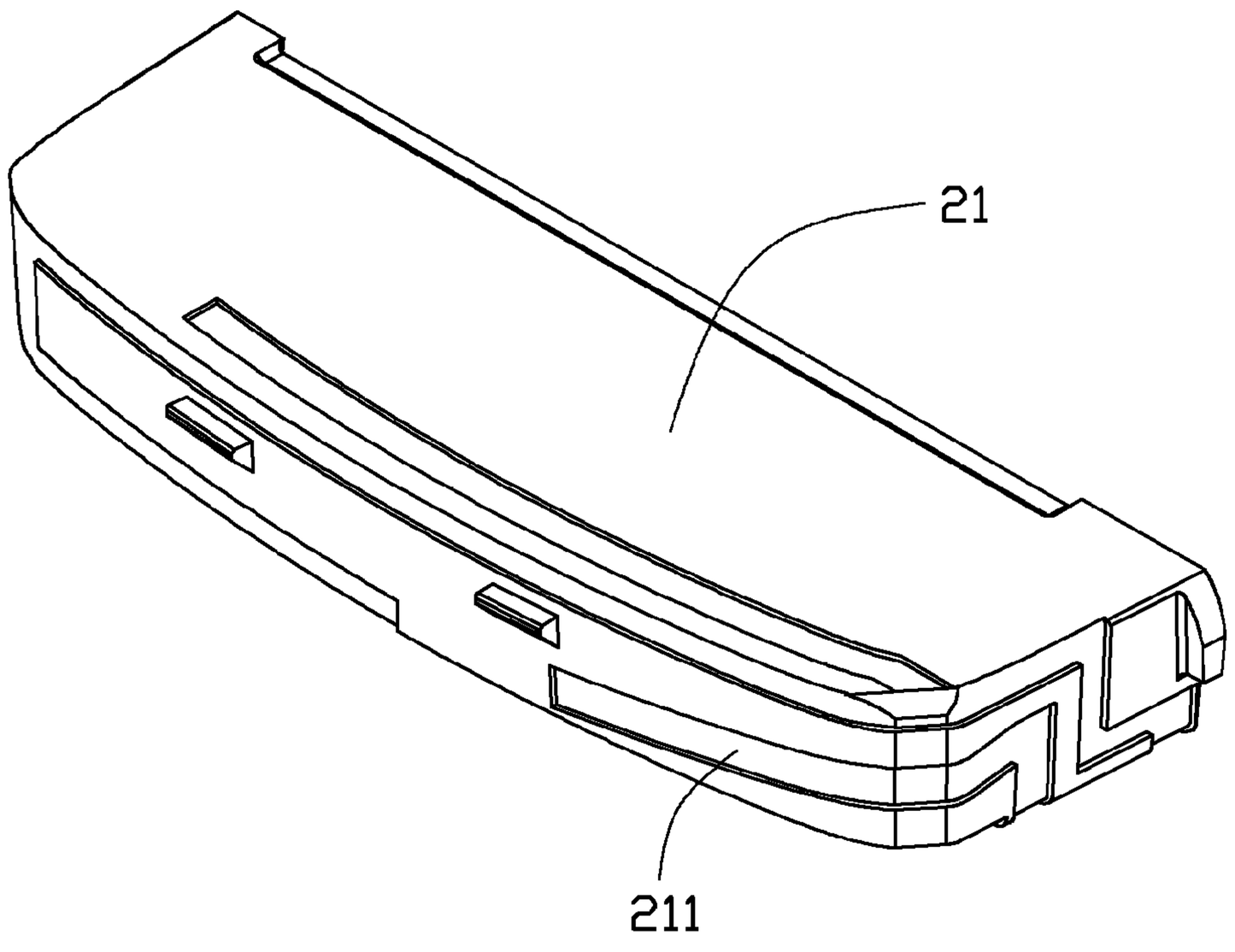


FIG. 3

ANTENNA MODULE AND METHOD FOR MAKING THE SAME

BACKGROUND

1. Technical Field

The present disclosure relates to antenna modules and methods for making the same, and particularly, to an antenna module used in a portable electronic device and a method for making the same.

2. Description of Related Art

Portable electronic device generally includes an antenna module to transmit and receive electromagnetic waves. Laser Direct Structuring (LDS) is a method recently used to manufacture antennas. Manufacturing antennas by LDS process commonly includes three steps: forming a plastic substrate using modified plastics which can be laser-activated to be conductive; focusing a laser on a predefined region of the surface of the plastic substrate to make metal crystals contained in the modified plastics spread to cover the predefined region; and depositing a conductive metal coating on the predefined region to form the antenna. The LDS antenna can be designed with many suitable three-dimensional shapes according to frequencies to be used. However, the modified plastics used for the LDS antennas are very costly and such process can reduce processing efficiency and increase production times.

Therefore, there is room for improvement within the art.

BRIEF DESCRIPTION OF THE FIGURES

Many aspects of the antenna module and method for making the same can be better understood with reference to the following figures. The components in the figures are not necessarily drawn to scale, the emphasis instead being placed upon clearly illustrating the principles of the antenna module and method for making the same. Moreover, in the drawings like reference numerals designate corresponding parts throughout the several views.

FIG. **1** is a schematic view of an antenna module, according to a first embodiment of the present disclosure.

FIG. **2** is an exploded view of the antenna module shown in FIG. **1**.

FIG. **3** is a schematic view of a main body of the antenna module, according to a second embodiment of the present disclosure.

DETAILED DESCRIPTION

Referring to FIG. **1** and FIG. **2**, an antenna module **100** according to a first embodiment of the present disclosure includes a main body **11** and an antenna radiator **13** located on the main body **11**. In this embodiment, the antenna radiator **13** is three-dimensional.

The main body **11** is molded using non-conductive plastics. The non-conductive plastics may be one or more materials selected from a group consisting of polypropylene (PP), polyamide (PA), polycarbonate (PC), polyethylene terephthalate (PET), and polymethyl methacrylate (PMMA). The antenna radiator **13** is a conductive layer formed according to a predetermined shape. The conductive layer is made of metal, such as Silver (Ag) or Copper (Cu).

A method for manufacturing the antenna module **100** is described as follows:

The main body **11** is molded through injection molding. A dispenser (not shown) which allow a three-dimensional guidance of a nozzle of the dispenser is used for forming antenna

radiator **13**. The dispenser is an automatic device used to dispense a liquid or a paste on an object. A liquid or pasty conductive material mixed by Ag powders and a diluting agent is fed into the dispenser. The diluting agent is an organic solvent which is mainly made of xylene. The diluting agent can improve the liquidity of the conductive material for allowing the conductive material to get out from the nozzle of the dispenser.

A motion path of the nozzle and a flow of the conductive material got out from the nozzle are set up through programming on the dispenser. The motion path of the nozzle can be referred to as a predetermined path. In this embodiment, the predetermined path corresponds to the pattern of the antenna radiator **13**. The flow of the conductive material can be set up through the dispenser according to a thickness parameter of the antenna radiator **13**.

The conductive material is coated on the main body **11** by the dispenser according to the predetermined path. Subsequently, the main body **11** is baked at a temperature of about 70° C.~150° C. The main body **11** may be baked for a few hours. During baking, most of the diluting agent is volatilized, and the remaining is solidified. The baking effectively improves a bonding force between the conductive material and the main body **11**. Accordingly, the antenna radiator **13** is formed on the main body **11**.

The conductive material can be coated on the main body **11** according to a predetermined path, not limited by the shape of the main body, thus the antenna radiator **13** can be designed with many suitable shapes. Comparing with LDS antennas, the antenna module **100** can be more easily produced and has a lower cost.

Referring to FIG. **3**, an antenna module according to a second embodiment of the present disclosure is similar to the above-described antenna module **100**, differing in that a groove **211** is defined in a main body **21** during the injection molding. The shape of the groove **211** corresponds to a pattern of an antenna radiator (not shown) located on the main body **21**. The above-described conductive material is filled in the groove **211** by a dispenser. Subsequently, the main body **21** is baked and the antenna radiator is formed on the main body **21**.

It should be understood, however, that even though numerous characteristics and advantages of the present embodiments have been set forth in the foregoing description, together with details of the structures and functions of the embodiments, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, and arrangement of parts within the principles of the present disclosure to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

What is claimed is:

1. An antenna module, comprising:

a main body; and

an antenna radiator located on the main body;

wherein the antenna radiator is made of a liquid conductive material mixed by metal powders and diluting agent and is directly formed on the main body, the diluting agent is made of xylene.

2. The antenna module as claimed in claim **1**, wherein the metal powders is made of Ag or Cu.

3. The antenna module as claimed in claim **1**, wherein the main body is molded through injection molding.

4. The antenna module as claimed in claim **3**, wherein the main body is made of plastics which are one or more materials selected from a group consisting of polypropylene (PP),

polyamide (PA), polycarbonate (PC), polyethylene terephthalate (PET), and polymethyl methacrylate (PMMA).

5. The antenna module as claimed in claim **3**, wherein the antenna radiator is three-dimensional, a groove corresponding to a pattern of the antenna radiator is defined on the main body, and the liquid conductive material is filled in the groove.

6. The antenna module as claimed in claim **5**, wherein the predetermined path corresponding to the pattern of the antenna radiator is set up through programming on a dispenser.

7. The antenna module as claimed in claim **1**, wherein the main body is baked at a temperature of 70° C.~150° C. to volatilize most of the diluting agent, and the remaining diluting agent is solidified.

8. A method for making an antenna module, the method comprising:

molding a main body;

coating a conductive material mixed by metal powders and diluting agent on the main body according to a predetermined path, the diluting agent made of xylene;

baking the conductive material to form an antenna radiator on the main body.

9. The method as claimed in claim **8**, wherein the metal powders is Ag or Cu powders.

10. The method as claimed in claim **8**, wherein the main body is made of plastics which are one or more materials selected from a group consisting of polypropylene (PP), polyamide (PA), polycarbonate (PC), polyethylene terephthalate (PET), and polymethyl methacrylate (PMMA).

11. The method as claimed in claim **8**, wherein the antenna radiator is three-dimensional, a groove corresponding to a pattern of the antenna radiator is defined on the main body and the liquid conductive material is filled in the groove by a dispenser.

12. The method as claimed in claim **11**, wherein during baking, most of the diluting agent is volatilized, and the remaining diluting agent is solidified.

13. The method as claimed in claim **12**, wherein the main body is baked at a temperature of 70° C.~150° C.

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